The Implications of HO and IRS Theories in Bilateral Trade Flows within Sub-Saharan Africa

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Abstract

Sub-Saharan-Africa (SSA) countries tend to trade less within themselves. This paper analyses the driving forces of bilateral trades within the SSA region. To do so, I use the gravity equations from Evenett and Keller (2002) and study what trade theories, the Heckscher-Ohlin (HO) theory of factor abundance or the increasing return to scale (IRS) theory of product differentiation, account for the bilateral trade flows within this region. My results indicate that trades within this region do not arise from the factor abundance or product differentiation. Trade policies that aimed to promote trade within the region (i.e., FTA, custom unions) are likely to fail because SSA countries produce similar homogeneous products. The key factor for economic success from international trade for the SSA region relies on how to export their comparative advantage goods outside the region.

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[1] Their measure of a country's trade potential includes factors like: economic size- GDP per capita; trade intensity- the ratio of trade to GDP; the geography of the country (area, island or not island).

1. Introduction

The international trade flows within Sub-Saharan-Africa (SSA) countries have been low historically relative to both, the region's trade flows with other regions and trade within some other regions. Manner and Behar (2007) point the share of SSA countries' inter-regional trade in their total trade volume exceeds 80 percent. They argue that the lower trade within the region is due to tariffs and non-tariff barriers. Hanink and Owusu (1998) develop the trade intensity index on the basis of a spatial interaction model to examine the trade within the economic community of West African States (ECOWAS). Their result shows that ECOWAS has failed to promote trade between its members. Mansoor et al., (1989) measure trade potential intra-SSA as the value of SSA's import from the rest of the world of products that at least one SSA country is significantly exporting (at least 1 percent of its total export to the rest of the world). They use the disaggregated UNCOMTRADE data at 4-digit SITC and find that the intra-SSA trade potential was only 16 percent of the region's total export in year 1983.

In fact, the gravity equation predicts lower trade flows within SSA relative to trade between SSA and the rest of the world. Faezeh and Pritchett (1993) compare the actual intra Sub-Saharan African trade to the predictions of the gravity equation. They construct a gravity equation in which the trade volume between two countries is a function of the trade potential[1] of each of the countries and the trade attraction[2] between them. Using import and export data from

[1] Their measure of a country's trade potential includes factors like: economic size- GDP per capita; trade intensity- the ratio of trade to GDP; the geography of the country (area, island or not island).
[2] The trade attraction is determined by: The distance between the two countries used as the proxy for the transport cost; common language and political barriers to trade.

the UNCOMTRADE at 3-digit SITC, they find that the predictions[3] of the gravity equation are similar to the actual trade.

The debate about the regional trade in SSA remains one of the critical issues when it comes to economic development. The importance of this issue has led the regional leaders to engage in multilateral free trade agreements and subdivide the region into overlapping custom unions and free trade areas. Despite all arrangements to boost the regional trade, import flows in SSA remain low. In fact, imports of Africans from Africans have never exceeded 20 percent of the region's imports from the remaining world nor exceeded 25 percent of its exports towards the rest of the world (see details in the next section).

The literature has stressed that SSA countries trade less among themselves and authors have pointed out some potential causes. Among others, tariff and non-tariff barriers, poor transport infrastructures, and poor private participations have been underlined to explain the curse (e.g., Alemayehu and Haile, 2008; Buys, Uwe and Wheeler, 2010). However, no author has investigated the implications of the region's factor endowments and its level of product differentiation in explaining the lack of comparative advantage in production within SSA and understanding why trade flows remain low in this region. The difference in factor endowments and the product differentiation are important in enhancing trade between countries. The dramatic disturbances in the African trade as a result of the high volatility in the world primary commodities prices during the last decade has led Paul Breton et al. [4] (2011) to conclude that the key development solution for Africa remains export diversification. Although not empirically

[3] The actual imports and exports within SSA were respectively 8.1 and 4.5 percent of the region's trade with the rest of the world, while the predictions of the gravity equation were 7.5 for import and 4.5 percent for export.
[4] Africa Trade Policy Notes No. 15 - The Poverty Reduction and Economic Management Department of the Africa Region of the World Bank

explained, producing differentiated products is one of the main challenge African countries must undertake to boost their regional trade.

The Goal of this paper is to examine the driving forces of bilateral trade within SSA. In particular, I investigate whether regional trade of SSA arises from cross-product specialization resulting from difference in factor abundances (Heckscher-Ohlin) or from intra-industry trade resulting from increasing returns to scale (IRS) production technology and product differentiation.

My results show that the differences in factor endowment ratios within SSA are low, which indicate trade does not arise from cross-product specialization. In fact, 60 percent of the region's imports are made of homogeneous goods. The average regional Grubel-Lloyd index is approximately 0.03 over the period I consider. The low value of the Grubel-Lloyd index indicates that there is less possibility of gain from exchanging varieties. The limited patterns of product varieties cannot generate intra-industry trade within the region. The alternative to achieve economic success through trade for SSA countries can be the inter-regional trade. Targeting the access to markets in advanced economies might benefit to African countries in the sense that they will have the comparative advantage over the capital abundant countries in producing their primary commodities (i.e., agricultural and labor intensive goods).

This paper shows that the conditions for specialization in production under both HO and IRS theories are not met in SSA. There is little room for comparative advantage in production across SSA countries. The empirical results in this paper imply that industrialization and manufacturing product in varieties is crucial in boosting the region's trade in the long run.

The remainder of this paper is organized as follow: Section 2 gives an historical overview of SSA trade. Section 3 briefly reviews the literature on trade theories. Section 4 outlines the methodology, explains the model, and summarizes the data and sources. Section 5 shows the investigation results and their implications while section 6 concludes the paper. Tables (2-8) are provided in the appendix.

2- Overview of Sub-Saharan Trade

2.1- Product Composition of Sub-Saharan Africa Trade

The bilateral imports of non- fuel products of African countries from other African countries are mainly composed of primary commodities. These commodities are agricultural goods and manufactured[5] goods that mainly consist of consumer goods. Although primary commodities, the composition of the African products has changed over the last decades. This change in the composition of the goods in SSA has remarkably affected the rate of imports within the region. In fact, between 1970 and the late 1980s, a large proportion of commodities traded in SSA consisted of agricultural goods. The share of manufactured goods was low relative to that of agricultural based goods up to the 1980s. Noticeably, over that period the total import level within SSA was stagnant and low (see Figure 1 and 2).

[5] Note that the manufactured goods used in this examination do not include machinery and transport equipment. The reason for the exclusion is because a large portion of machinery and transport equipment imported within SSA are products of China and India. In recent decades, trade has intensified between India, China and Africa. As Broadman (2007) explains, this increased partnership is due to the economic complementarities between the two regions. The Asian countries essentially export machinery and transport equipment towards some key African countries like South Africa and Nigeria. From these countries, the commodities are imported by other countries in the region (see Kaplinsky et al., 2006). Thus, machinery and transport equipment are not value added products of SSA.

From the second half of the 1980s, the share of manufacturing goods in the total import started to increase. The proportion of the manufactured goods in the total imports value within SSA surpassed that of the agricultural goods in the mid-1990s. As shown in Figure 2, it is remarkable how the curve of intra-SSA imports changed from being flat to gradually have an upward sloping trend. There has been the argument that the dramatic increase in the regional imports results from the increase in the world demand for primary commodities, which inflated their prices (see Gupta and Yang, 2006; Paul Breton et al., 2011).

However, during the 90s, there was no such a huge increase in the world demand for primary commodities. But the trend of the regional imports had started to increase then. I argue that the moderate increase in intra- SSA imports in the 90s was mainly due to the growth in manufactured goods over that period. Even though inflation in primary commodities prices has contributed to the seemingly high imports within SSA during the last decade, not all of the increase in the regional imports in the 2000s resulted from accelerated demand for primary commodities in world. Some of the increase in intra- SSA imports in the 2000s comes from the high share of manufactured products relative to agricultural goods over that period.

In fact, when inflation is accounted for, the real[6] value of imports within SSA still increases simultaneously as the share of manufactured goods increases and decreases when the share of manufacturing goods decreases (Table 1). In the 90s the share of manufactured goods in imports in SSA significantly increased and surpassed the value share of Agricultural goods in the late 1990, this is the period where the regional import started to increase. From early 2000s, the share of manufactured goods in total imports has declined but is still above that of agricultural goods and the regional imports are rising. Even, after deflating the prices, imports remain relatively high over the 2000s. The higher proportion of manufactured goods relative to

[6] The real value of imports is computed using consumer price index (CPI) from the WDI, year 2005=100.

agricultural ones explains why the real imports within SSA lies above its levels of 1990s, though it has declined.

The overview of the non-fuel commodities within SSA shows two main points. First, commodities prices in SSA are dependent to world prices and so vulnerable to external shocks. This is essentially because the commodities of SSA consist in general of primary commodities. The second point is that manufacturing has positive effects on imports within SSA. After controlling for inflation, the total imports within SSA increases together with the share of manufactured goods. When the market share of manufactured goods increases, total imports increases and declines when manufactured goods shrink. This fact highlights the importance of product differentiation in enhancing bilateral trade. Indeed, manufacturing goods is the basis for product differentiation. SSA countries will boost their regional trade through product differentiation.

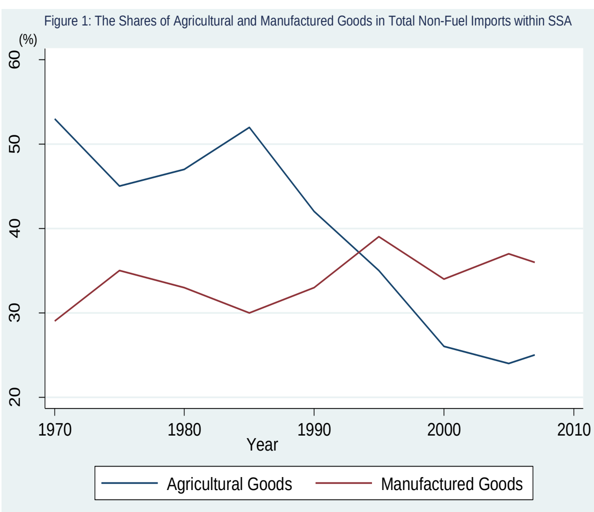

Figure 1: The Shares of Agricultural and Manufactured Goods in Total Non-Fuel Imports within SSA

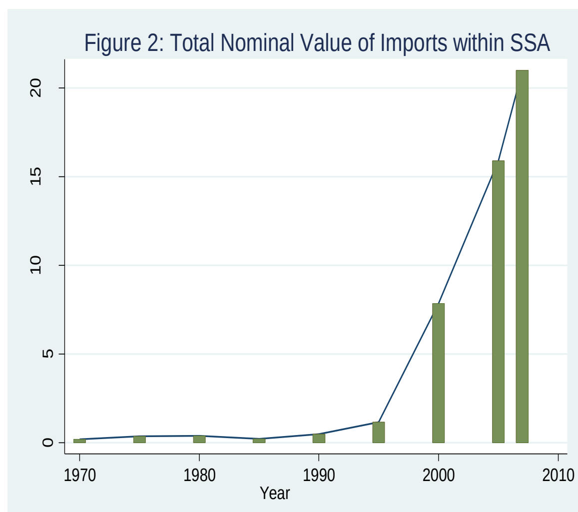

Figure 2: Total Nominal Value of Imports within SSA

Table 1: Real Value of Imports within SSA

Year	Real Import Value (Million $U.S.)
1970	182
1975	335
1980	354
1985	212
1990	453
1995	1060
2000	128000
2005	12400
2007	13100

Source: UNCOMTRADE Data, 1-Digit SITC

Although, the share of agricultural goods in imports within SSA has declined and the share of manufactured goods has relatively increased, imports within SSA remain largely low compared to the region's imports and exports with the rest of the world; Indicating that the level of manufacturing is still too low to highly promote trade in the region. In the next sub-section I compare the values of imports within SSA to the region's trade towards the rest of the world.

2.2- Trade within SSA versus Trade of SSA with the Rest of the World

Historically, SSA trades a smaller share of its GDP among itself relative to the portion of its GDP that it shares with the rest of the world. To identify how much are imports within SSA relative to SSA's imports (exports) from (to) the rest of the world, I use the aggregated data at UNCOMTRADE (1- digit SITC) to compute the yearly total export (import) values of SSA towards (from) the rest of the world and the yearly total import value of SSA within the region. The ratios of imports within SSA to exports of SSA and imports of SSA from the rest of the world are shown in Figure (3, 4). Moreover, I calculate the values of SSA's import and export per partner outside the region, and import value per partners within the region (Figure 5). The observation reveals that the imports within SSA have always been smaller than the region's trade – both imports and export with the remaining world.

SSA imports more from the world than within itself. As shown in Figure (4), the proportion of the intra-regional imports in SSA's imports from outside the region has been historically less than 10 percent. This proportion reached some 20 percent in the mid- 2000s. According to Gupta and Yang, 2006 and Paul Breton et al. (2011), the relatively success of the intra SSA trade in the mid-2000s was essentially due to the worldwide increase in demand for primary commodities prices. However, from the above sub- section, the rise in manufacturing goods contributed to some extents for this success. Both- the ratios of the regional imports to external exports and imports increased from the late 80s to the mid- 2000s and then decline the following years. The periods of the increase and decrease in these ratios coincide with the period when the share of manufacturing goods raised and declined. Thus, manufacturing can explain some part of the success. Despite the contribution of manufacturing, the regional trade is still not a grand success.

Given the larger economic size of the rest of the world relative to the size of SSA, one might argue that the ratios of SSA's regional imports to its trade outside the region are reasonable. However, the trade value per partner inside and outside the region supports that SSA trades less among itself. Figure (5) shows the average value of SSA's export and import per partner outside the region and the average import value per partner within the region. SSA's import and export values of per partners outside the region largely exceed that per partner inside the region.

Despite the improvement in trade within SSA during the last decade, the trade flows within the region still low. Different factors might explain the curse. However, this paper focuses on analyzing the factor endowments and the extent of product differentiation within SSA to explain why the regional trade is still low. In the next sub-section I briefly review the literature on trade theories before presenting the methodologies of the empirical study.

Figure 3: Ratio of Imports within SSA to Exports of SSA to the World

Figure 4:Ratio of Imports within SSA to Imports of SSA from the World

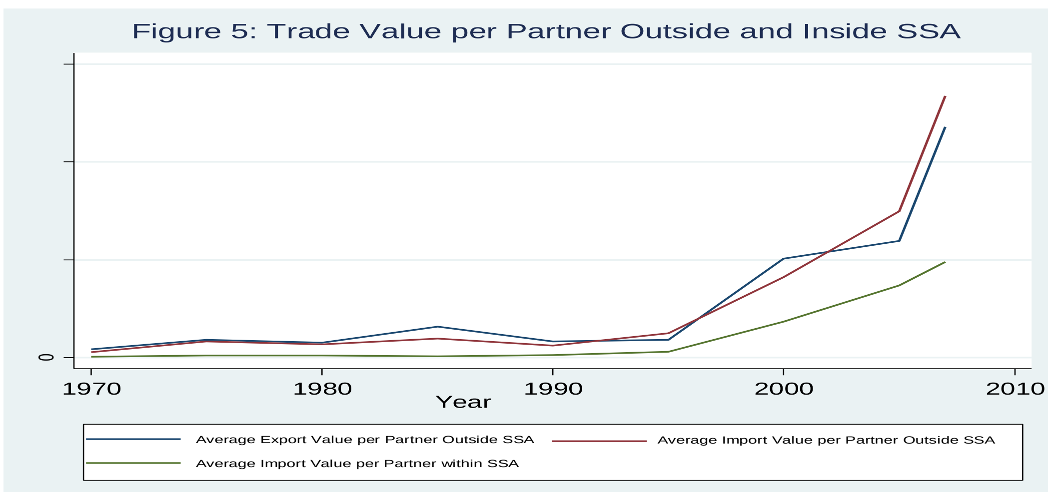

Figure 5: Trade Value per Partner Outside and Inside SSA

3- Brief Literature on Bilateral Trade Theories

3. Brief Literature on Bilateral Trade Theories

The Heckscher-Ohlin model is the trade theory initiated by Heckscher (1919) and reformulated by Ohlin (1933). It is known also as Heckscher-Ohlin Samuelson (HOS) because of the works of

Samuelson (1948, 1949) that added some mathematical insights to the model. This theory provides a basic for empirical analysis of the origins of the comparative advantage. The model proposes that factor endowments are sources of comparative advantage under two key assumptions: (1) the immobility of the factors of production across border: factors are immobile across borders but move freely across industries within a country, (2) factor abundance does differ across countries but does not differ too much so that countries are within factor price equalization (FPE). The relative factor endowment differences can lead to comparative advantage across countries. Within an industry this will reflect the relative intensity of one factor over others in the production of a good or the marginal rate of substitution between factors in the production process.

For bilateral trade to be enhanced within SSA, the countries must specialize in particular goods or services in the production of which they have the comparative advantage over other countries. According to the HO theory, countries export the goods that they produce intensively with their abundant factor. Thus, a labor abundant country will tend to export goods that require labor intensively in their production while the factor contents of trade from a capital abundant country will be capital intensive. In this case when two countries have similar factor endowments, they will tend to trade less with each other because their factor contents of trade are homogeneous.

The foundation of the Heckscher-Ohlin theory of trade is the immobility of the factors of production between countries. Moreover, the model assumes that different combinations of these factors are used in the production of different goods (Leamer, 1984). Based on the HO theory, if a country i is abundant in factors that are used intensively in the production of a given good Z, this country will have the comparative advantage in the production of that good Z

over other countries. Thus, country (i) can specialize in the production of good Z and export it to other countries that produce this good with higher opportunity costs. The importance of the HO theory in analyzing trade patterns is that it allows measuring factor intensity in traded goods, factor abundance and the trade flows.

Bilateral trade between two countries can also be intensified as a result of product differentiation where the love of varieties creates demand for products across countries. Krugman (1979) originated the theoretical framework for the product differentiation- IRS under monopolistic competition and was followed by a wide range of works (i.e., Krugman, 1980; Bergstrand, 1989; Eaton and Kortum, 2002; Helpman, Melitz, and Rubinstein, 2008). This type of trade has been proven to be the driving force of bilateral trade among industrialized nations. Helpman (1987) and Dabaere (2002) show[7] that the large portion of trade between developed nations is made of trade between industries producing different varieties of a product. The IRS theory is relevant in analyzing trade in SSA, and to see whether specialization due to product differentiation can occur in the region.

The HO theory as well as the IRS theory form basics for empirical investigations on international trade patterns. Moreover the gravity equation which remains the most successful model in explaining the variations in trade volume between country pairs can be derived from any of these theories (e.g., Helpman and Krugman 1985). There have been controversy about which of the HO and IRS accounts for the success of the gravity equation. However, Evenett and Keller (2002) shows that each of the theories explain different components of the equation. I use

[7] Helpman (1987) used a gravity model and provided support that the trade volume within a region relative to the regional GDP is proportional to the dispersion index that measures the regional degree of intra-industry trade. Debaere (2002) tested the results of Helpman (1987) on the samples of 14 OECD countries where product differentiation is of great importance and another sample of Non OECDs with less differentiated goods. He concluded that the increasing similarity in GDP among the OECD countries leads to higher bilateral trade whose large proportion consists of intra-industrial trade.

Evenett and Keller's framework and study the driving forces of trade within the SSA. And identify whether this region exhibits opportunities for specialization based on the two theories.

4- Methodologies

I follow the empirical strategies[8] of Evenett and Keller (2002) who tackle the factor endowment difference and the increasing return to scale theories of trade in a single gravity equation. They study to what extent each of the theories explains the bilateral trade flows. I apply their methodology to the bilateral trade within SSA region and compare it with that of other regions. The model of Evenett and Keller (2002) is convenient under the goals of this paper because it can test the endowment based issue and product differentiation as opposed to firm level.

4. 1. Trade Theories and the Gravity Equation

Evenett and Keller (2002) present a gravity model in which the value of imports of a country i from a country j at time t is proportional to the product of the GDPs of the two countries (Y^i and Y^j) divided by world GDP at that time assuming identical technology across countries, homothetic preferences:

$$M^{ijt} = \frac{Y^{it}Y^{jt}}{Y^{wt}} \qquad (1),$$

[8] Because my objective is to examine the driving forces of trade within the region, I use the framework provided by Evenett and Keller (2002). The recent extensions of the gravity equations include Eaton and Kortum (2002) and Helpman, Melitz, Rubinstein (2008). Both of the models introduce firm-heterogeneity into the gravity equation. Eaton and Kortumn build on the Ricardian model to incorporate geographical barriers to trade. Geography influences economic activities and the choice of firms' location. Helpman, Melitz, and Rubinstein (2008) introduce a model of firm heterogeneity in Melitz (2003) that accounts for the impacts of extensive and intensive margins.

where $M^{ijt}, Y^{it},\ Y^{jt}, and\ Y^{wt}$ are respectively imports of country i from country j, GDP of country i, GDP of country j and the world's GDP at time t (hereafter, superscripts i and j represent country indexes and t is the time index). This paper modifies equation (1) to apply it to intra-regional trade study. I replace the denominator (world GDP) in equation (1) by regional GDP so each region represents its countries' world.

$$M^{ijt} = \frac{Y^{it}Y^{jt}}{Y^{rt}} \qquad (2),$$

where, Y^{rt} is the regional GDP (hereafter, superscript *r* represents region index). Equation (1) or (2) above have very important theoretical features. They hold as long as countries completely specialize. Moreover, these equations can be derived from the product differentiation, complete specialization across varieties, as well as the cross-industry specification arising from factor endowment differences.

The increasing return to scale theory states that the love of varieties is what creates demand for goods across borders. Each country however demands the varieties of differentiated goods from its partners relatively to its GDP. If the two countries produce a common good (Z) (homogeneous good) and different varieties of another good (X) (differentiated product), then each country will import different varieties of the differentiated good from the other country, but not the common good. Based on the homothetic preference, the quantity of varieties of goods country i imports from j is a function of its share of the world GDP which in this case is $\frac{Y^{it}}{Y^{rt}}$. Nevertheless, the quantity of product varieties country i expects to import from j is reduced the more the share of homogeneous goods between the two countries.

The reason why bilateral trade between the countries declines in the presence of homogeneous good is the following: The two partner countries produce a given amount of a homogeneous commodity Z. The shares of the good Z in i and j's GDPs are respectively Z^i and Z^j. Country i's share of varieties in its GDP is (1-Z^{it})Y^{it}. Thus i's share of world (regional) market is $(1 - Z^{it})\frac{Y^{it}}{Y^{rt}}$ If there were no common good produced in both countries, the importing country would import all varieties from the partner at the full value of its share in the world GDP ($\frac{Y^{it}}{Y^{rt}}$); then, equation (2) where the coefficient of the left hand side is unity would hold. That is, i imports hundred percent of the different varieties from j so does j from i. With the existence of common good Z, the total imports of i from j is reduced by the share Z^{it}. Incorporating the share of homogeneous goods in equation (2) gives

$$M^{ijt} = (1 - Z^{it})\frac{Y^{it}Y^{jt}}{Y^{rt}}. \qquad \textit{(3),}$$

We would expect high regression coefficients for countries where products are differentiated than for countries with homogeneous goods. That is for $Z^{it} > 0$ the trade volume between partners declines. Consequently, countries with high Grubel Lloyd index will tend to have high alpha α ; Where $\alpha^{it} = 1 - Z^{it}$. Equation (2) holds perfectly to test trade based on the endowment differences between countries as well.

In the world of two countries, two goods and two factors Heckscher-Ohlin model, each country export the good that uses intensively its abundant resources. If country i and j are respectively capital and labor abundant and produce two homogeneous goods Z and X, the first country will export capital intensive goods and the second the labor intensive good. Suppose the production of good X requires more capital while Z is produced intensively with labor and both goods are produced in both countries. The amount of goods X and Z produced in country i are respectively $\frac{X^{it}}{(X^{it}+z^{it})}$ and $\frac{z^{it}}{(X^{it}+z^{it})}$ with $\frac{X^{it}}{(X^{it}+z^{it})} > \frac{z^{it}}{(X^{it}+z^{it})}$. In the other hand, country j produces the shares $\frac{z^{jt}}{(X^{jt}+z^{jt})}$ and $\frac{X^{jt}}{(X^{jt}+z^{jt})}$, with $\frac{z^{jt}}{(X^{jt}+z^{jt})} > \frac{X^{jt}}{(X^{jt}+z^{jt})}$. Country i exports a demanded proportion α^x of its production X^{it}. Thus the world (regional) market share of i is:

$M^{ijt} = \frac{\alpha^x}{X^{it}}(\frac{Y^{it}Y^{jt}}{Y^{rt}})$. The market share of j is $M^{jit} = \frac{\alpha^z}{z^{it}}.(\frac{Y^{it}Y^{jt}}{Y^{rt}})$.

Let $\gamma^{it} = \frac{\alpha^x}{X^{it}}$ and $\gamma^{jt} = \frac{\alpha^z}{z^{it}}$. Then $M^{ijt} = \frac{\alpha^x}{X^{it}}(\frac{Y^{it}Y^{jt}}{Y^{rt}}) = \gamma^{it}(\frac{Y^{it}Y^{jt}}{Y^{rt}})$ and

$M^{jit} = \frac{\alpha^z}{z^{it}}(\frac{Y^{it}Y^{jt}}{Y^{rt}}) = \gamma^{jt}(\frac{Y^{it}Y^{jt}}{Y^{rt}})$.

From the above demonstration, we would expect γ^{jt} and γ^{it} to be higher when the capital to labor ratios differ sharply across the two countries at a particular time *t*. This is because the large difference in factor endowment will cause each country to specialize in the production of the good it produces intensively with its abundant factor, and rely on its partner for the consumption of the other good. By relying on each other the demand increases between them. γ^{jt} and γ^{it} decrease when endowment ratios converge between the countries. In the extreme case if both countries are capital or labor abundant, α^x or α^z will tend to zero. This will characterize the "no trade" in a Heckscher-Ohlin model when endowments are identical. The coefficient γ from estimating equation (3) is expected to be smaller when factor endowments are similar or/and when products are not differentiated (in the presence of large shares of homogeneous goods).

Additional modifications from equation (1) are the inclusion of the dummy for common language – if the two countries have a common official language (CL^{ij}); the dummy for colonial links if the importing country was a colony(col^i); the dummy for contiguity if the two countries share a common border ($contig^{ij}$); the log of the distance between the two countries (D^{ij}) and the landlocked dummy (LL^i). After inclusion of these control variables, equation (3) becomes:

$$M^{ijt} = \alpha^{it}(\frac{Y^{it}Y^{jt}}{Y^{rt}}) + \beta CL^{ij} + \delta col^{i} + \theta contig^{ij} + \vartheta D^{ij} + \rho LL^{i} + \varepsilon^{ij\,t} \quad (4),$$

This paper estimates equation (4) using a panel pooled ordinary least square (OLS). Baltagi and Khanti-Akom (1990) stresse that the Haussmann-Taylor (hereafter, HT) (1981) estimation methodology is the best estimator for equations where potential correlation might exist between the explanatory variables and the individual specific effects. Baltagi and Khanti-Akom (1990) argue that with the HT estimation method, the within transformation does not eliminate the individual effects and it corrects the within estimator when individual effects are correlated with the explanatory variables. Another way to recover individual specifics is the use of fixed effect estimation. However, the fixed effect estimation automatically drops the time invariant variables. This is an issue with the gravity estimations where country specifics such as distance between countries, the common language, or common border between two countries or landlocked dummies are time invariant. If the time invariant variables are uncorrelated with the country pair effects, then one can recover the fixed effects using the two stage least square (2SLS), that is to estimate OLS on the residuals of fixed effect regression (see Baltagi, 2009).

For these econometric reasons, some gravity estimations have recently employed the HT estimation methodology. For instance, Serlenga and Shin (2007) estimate the gravity equation of bilateral trade among 15 European countries using the HT estimation methodology. They argue that in addition to recovering the country specific effects of variables like distance, common border, common language, the HT (1981) methodology allows these variables to be endogenous.

Even though the HT methodology tackles the endogeneity problem, I use the pooled OLS because the type of gravity equation I use in this paper allows little correlation between the explanatory variable and the dummies (country specifics). Serlenga and Shin (2007) used GDP the differences in relative factor endowment between trading partners (RLF), dummy on similarity in relative size (SIM), dummy on European community membership (CEE), common currency (EMU) and the common language dummies as the endogeneous variable when applying the HT methodology. Obviously, the design of their gravity equation exhibits potential endogeneity and it is reasonable for them to use the HT estimator. GDP, the relative country size and the difference in relative endowment variables could be much correlated; while most of the 15 European countries in the sample are members of the "CEE" and the "EMU".

The gravity equation by Evenett and Keller (2002) that I'm using is designed in such a way that the main explanatory variables are combined in the countries' sizes. The endowments proportion differences are intended to be part of the GDP and be reflected through the coefficient of the estimation. This main explanatory variable turn to be less correlated with the dummies which reflect the country specifics. The matrix of correlation between the variables is given in Table (6) and the results from estimating Equation 4 are in the Table (8).

4.2- The Data Summary

The historical overview of trade in SSA is observed over the period from 1970 through 2007 using the aggregated data at the 1-digit SITC of the UNCOMTRADE database. However, due to the lack of historical data on the capital stock and the labor force, the empirical investigation uses a panel of eleven years (from 1997 to 2007) on 118 countries grouped into five regions[9] to estimate equation (4). The list of SSA countries is reported in the appendix Table 1. The bilateral

[9] "Asia", "EU_NAM" , "LAC", "MENAF", and "SSA" denote respectively region of East Asia and Pacific and South Asia, Europe and North America, Latin America and Caribbean, Middle East and North Africa, and Sub-Saharan Africa

trade data is retrieved from the IMF's direction of trade (DOT) and "UNCOMTRADE". The data on real gross domestic product (RGDP) converted into purchasing power parity (PPP), capital stock, labor force, population are retrieved from the IMF's international financial statistics (IFS). The gross capital formation retrieved from the World Bank's world development indicator (WDI) data is adjusted by the depreciation rate of 6 percent. The gross capital formation is used as a proxy for countries' capital stock.

The data includes countries with valid data on capital stock and labor force. Note that capital and labor are used as the main factor endowments in this paper. Whenever a country lacks capital stock or labor force data for a given year, the countries pairs in which that country is involved is dropped out of the estimation. This is because the paper is interested in investigating the endowment ratio difference across countries. Once the endowment data of the partner is missing, it is difficult to compare. Moreover the paper computes the factor intensity embodied in the traded commodities to see whether the exporting country is capital or labor abundant relative to its partner.

All variables are converted in purchasing power parity adjusted in real U.S. dollars to be internationally comparable. The comparison across variables within a region is less likely to be bias because the degree of data quality does not vary a lot within a region. The number of trade relations per importing countries in each region, the countries' GDP per capita, and capital per worker are summarized in the appendix Table 2. The capital to labor ratio is also calculated for countries within each region and the average difference is reported in the appendix Table 3.

This paper follows the literature to test the rates of intra industrial trade by computing the Grubel Lloyd index. The data used to calculate the Grubel Lloyd index is extracted from UNCOMTRADE database on two-way trade in three digit standard international trade classification (SITC3). The purpose of grouping commodities by standard international trade classification is to ensure international comparability of international trade statistics. Each class casts the material used in the production of the goods, the processing stage, what the good is designed for, the importance of the commodity in the world demand and the technology level in the product's production (UNSTATS[10]). Testing SSA's trade using the SITC data is an opportunity to identify not only the types of commodities but also the processing stages of the merchandises, and their importance on the world market. Moreover, the use of the three digit classification level commodities allows including more categories of commodities (not limited to manufacturing goods). To assess the extent of product differentiation, the paper classifies the commodities by differentiated and homogeneous goods based on Rauch (JIE 1999) and Hallak (JIE 2006) concordance. Only the differentiated goods are used to calculate the IIT rates.

4. 3. The Degree of Intra-Industry Trade: Grubel-Lloyd Index.

The Grubel Lloyd (GL) index of intra-industry trade is computed for bilateral pair using two-way trade of goods in three digit standard international trade classification (SITC). I use the UNCOMTRADE data at 3-digit SITC because at this digit enough to assess the differentiated goods. The Grubel Lloyd index is computed using the following equation:

$$GL_g^{ijt} = 1 - \left[\frac{\sum_g | M_g^{ijt} - M_g^{jit} |}{\sum_g (M_g^{ijt} + M_g^{jit})} \right] \qquad (5),$$

where, $0 < GL^{ijt} \leq 1$, g represents a particular traded commodity, GL^{ijt} is the Grubel Lloyd index and reflects the intra industrial trade (imports and exports) of country i from (to) country j.

[10] http://unstats.un.org/unsd/class/family/family2.asp?Cl=14

M_g^{ijt} is the export value from country i to country j in differentiated goods and M_g^{jit} is imports value in the good g of country i from j. This index initiated by Grubel and Lloyd (1975) captures how industries across countries trade between themselves in differentiated goods.

The GL index reflects the amount of differentiated goods traded between industries located in different countries. This index can be assessed only if a good is simultaneously imported and exported by a country from (to) the other country. GL_g^{ijt} equals zero whenever g is either exported or imported only. In contrast, if the value of imports in commodity g is equal to the value of export in the same good, then GL_g^{ijt} equals unity. Therefore computing this index for SSA allows determining the proportion of the regional trade made intra-industrially in differentiated goods (see Grubel Lloyd 1975). The shares of differentiated and homogeneous goods out of the total trade volume as well as the capital to labor ratios are calculated to further highlight the nature of endowments and the characteristics of goods in SSA. This exercise is conducted for all regions to facilitate comparison of SSA to other regions. Note that the relatively higher GL_g^{ijt} index indicates intensive intra industrial trade or the existence of wide range of product varieties.

4- Results and Interpretation

4. 1. The Characteristics of Trade in Sub-Saharan Africa

Few countries with fewer merchandise patterns make up SSA's regional trade. For the period from 1997 to 2007, South Africa has been the leader in trade in differentiated goods with about 47 percent of the total regional market share. Kenya, Zimbabwe, Mozambique, Nigeria, Cote d'Ivoire and Ghana follow South Africa with respectively 4.55, 4.51, 4.17, 3.66, 3.61, and 3.49 percent of the regional market shares (Table 5 summarizes each country's total import and export values in differentiated goods, their average Grubel Lloyd index and their share of the regional trade volume over the eleven years period).

South Africa's main partners are Mozambique (with a share of 13.44 percent in South Africa's regional trade), Zimbabwe (13.3 percent), Zambia (12.8 percent), Angola (11.14 percent), Nigeria (6.4 percent), Malawi (5.8 percent), Congo, Democratic Republic (4.7 percent), Kenya (4.6 percent), and Tanzania (4.5 percent). The main goods that South Africa trades with her main partners: tobacco, metallic structures, furniture, road motor vehicle, alcoholic beverage, rubber tires, telecommunication equipment, aircraft equipment, wood simply worked, tools, electric machinery parts, printed matter and medicaments.

The main regional partners of Cote d'Ivoire have been Ghana (with a share of 16.7 percent in Cote d'Ivoire's regional trade), Burkina Faso (16.6 percent), Mali (15.3 percent), Nigeria (9.2 percent), Senegal (8 percent), and Togo (5.2 percent). The key commodities Cote d'Ivoire trades with its main partners are articles of plastics, Perfumery, cosmetics, Fertilizers, wood simply worked, cotton fabrics, ships, boats, footwear, electric distribution equipment, metallic structure and medicaments.

The partners of Kenya, Zimbabwe, Mozambique, and Nigeria are essentially the main partners within the partnership circle of South Africa and they exchange similar goods as with South Africa. In addition to the trade with the southern and eastern African countries, Nigeria also trades intensively with Cote d'Ivoire and within the partnership circle of Cote d'Ivoire in similar goods as Cote d'Ivoire. Although the trade in SSA is happening within well-defined groups, the goods traded within the region exhibit similar and limited patterns. The limitation of the commodities patterns and their invariance over time explains why trade is limited in SSA.

4. 2. The Endowment Proportion Analysis

The endowment analysis shows that SSA countries are in majority labor abundant. The ratios of capital to labor within SSA indicate that there is less capital available per worker in SSA as compared to that within other regions. In average, the value of capital per labor in SSA is $546 and it is the lowest as compared to the value of capital per worker in other regions (see Table 3). Factor endowment ratios are similar across countries in SSA than in other regions. The mean difference in capital to labor ratio in SSA is 845 and it is also the lowest among regions. In SSA, the minimum difference in the factor production ratio is between Burundi and the Democratic Republic of Congo (DRC), whereas the maximum difference in this ratio is between Equatorial Guinea and Zimbabwe. More than 38 pairs of countries in SSA exhibit no difference in factor endowment ratio (factor proportion difference ≈0 between the countries composing the pair).

The endowment ratio within SSA indicates that the region is labor abundant than capital relative to other countries. The implication of the nature of endowments in SSA countries is that the factor content of traded goods within the region is labor intensive than capital. Given the countries' endowments, the opportunity cost of producing capital intensive goods in SSA is high. Based on the endowment theory, SSA countries exhibit homogeneous factor content of trade. This is an indication of the lack of comparative advantage in the production of goods within the region. Therefore, specialization in production of goods based on the factor endowments is less likely to occur in SSA.

4. 3. Statistics on the Grubel Lloyd Index

Intra-industrial trade is almost missing in SSA. The average regional Grubel Lloyd index -which measures the rate of trade between industries across borders, is low in SSA compare to that of other regions (Table 4). The average Grubel Lloyd index is 0.03 in SSA and the index is zero for more than 60 percent of the countries over many years. The lack of intra- industrial trade reflects the fact that products are not differentiated in the region. Thus specialization based on the IRS theory cannot take place under these conditions. The factor endowment and increasing return to scale theories of trade explain why SSA countries trade less among themselves. Based on the HO theory the lower difference in factor proportions cannot generate perfect specialization within SSA whereas the absence of product differentiation undermines bilateral trade.

4. 4. The Results from the Gravity Equations

The coefficient alpha (α^{it}) from estimating equation (4) is lower for the regions where the share of homogeneous goods in total import is high. It is not surprising that Latin America, the Middle East and SSA have similar and low coefficients (α^{it}) compared to that of Asian and Europeans samples. In fact, Latin America, the Middle East and SSA have lower intra industrial trade–small Grubel Lloyd index. Moreover, these regions have higher share of homogeneous goods relative to the shares of differentiated goods in their total import. The average difference in the endowment proportions for these three regions are lower compared to that of Asian and European samples.

SSA has the lowest rate of intra industrial trade and the lowest average difference in the factor endowment ratios. SSA's coefficient alpha ($\alpha^{it} = 0.04$) being similar to that of Latin America and slightly greater than that of the Middle East might result from SSA having relatively higher share of differentiated goods in total imports compared to that of the other two regions. This indicates that SSA could trade more by differentiating its products.

Product differentiation and the relative endowment differences between countries are critical in enhancing bilateral trade. I merged all the samples and subdivided it into two subsamples using a benchmark of GL =0.05. The first subsample includes pairs countries with GL less than 0.05 and the second includes pairs with GL greater than 0.05. The subsamples include country pairs with valid number for the GL and difference in factor endowment ratio. The sample of lower GL contains 12,502 observations and that of higher GL has 18028 observations. I estimate equation (4) for each of the two subsamples. The coefficient (α^{it}) for the lower GL sample is 0.01 and that of the higher GL sample is 0.08. Both coefficients are significant at 99 percent confidence (see Table 7, last row- all observations). This indicates a 1 percent increase in the GDPs of countries within the low GL sample will increase trade between them by only 1 percent; while similar increase in GDP of countries within the high GL subsample will boost their bilateral trade by 8 percent. Clearly, product differentiation makes a large difference in the trade patterns between countries.

In addition, I subdivided each of the two subgroups into five classes named "$\boldsymbol{v}$" classes (***v*** =1, 2, 3, 4, 5). Within the lower GL group, ***v*** increases in the increasing order of the difference in factor endowment ratios (DFER). This means for instance that the DFER in the class of ***v*** =5 is greater than that of the ***v*** =1 class. There are about 2,500 observations per ***v*** class within the low GL subgroup. Similar ***v*** classes are also created in the high GL group. However, there are two ordering types in this subsample of high GL. The ***v*** classes are first ranked by increasing GL order and then by increasing DFER order. The ***v*** classes of the higher GL have about 3,605 observations each. After creating the ***v*** classes, I estimate equation (4) for each class sample following the same estimation methodology- pooled panel OLS.

As shown in Table 7, within the low GL subsample, the estimation coefficients are all significant at 95 percent confidence. The coefficients (α_{ϑ}^{it}) increase as the DFER increases. The largest level is reached for ***v*** =4 class with $\alpha_{\vartheta}^{it} = 0.012$. The class ***v*** =5 has a lower coefficient relative to that of the class ***v*** =4. This lower coefficient for the class ***v*** =5 could result from many countries in this class having extremely lower GL despite higher DFER between pair countries. Similar pattern of the coefficients α_{ϑ}^{it} is observed within each of class ordering types in the high GL sample. For the classes ranked by increasing GL order, the coefficients α_{ϑ}^{it} increase as the GL rate increases and the maximum value of $\alpha_{\vartheta}^{it} = 0.26$ is obtained at the class ***v*** =4. In the other ordering classes within the high GL (***v*** class increase by increasing DFER), the coefficients seem not to change much across the three first classes. But these coefficients are high for the last two classes.

What is remarkable from this "***v***-classes" estimation analysis, is that the coefficients (α_{ϑ}^{it}) are statistically significant and large in magnitude for all ***v*** classes and orderings within the high GL sample than within the low GL sample. Moreover, within the high GL sample, the higher ***v*** classes have higher α_{ϑ}^{it} in each of the two ordering. That is, the higher the GL and the higher the

DFER, the more the bilateral trade flows between the countries, indicating the importance of product differentiation and the relative differences in endowments ratio in enhancing trade. The IRS and the HO explain why trade flows are low in SSA. The lower factor endowment ratio differences and the less extent of product differentiation cannot generate perfect specialization. Given these results, trade policies like custom unions or free trade agreements are likely to fail in SSA. SSA countries have similar factors of production, they produce homogeneous primary commodities and the level of product differentiation is not high enough to allow specialization and increase demand across the border. To boost trade within SSA, the trade policies must be oriented to how to manufacture the region's goods in different varieties.

5- Conclusion

The findings of this paper support those of the previous works stating that SSA trades less within itself. However, this paper uses the HO and IRS theories to shows that the lack of comparative advantage in production is an impediment to bilateral trade in Sub-Saharan Africa (SSA). I argue in this paper that the homogeneity of factor proportions and the lack of product varieties slow demand across borders in SSA. Similar factor endowment ratios and the insignificant extent of product differentiation in SSA cannot generate specialization in production and enhance the regional trade. Based on these results, trade policies that aim to promote trade within the region (i.e., FTA, custom unions) are likely to fail because SSA countries produce similar, homogeneous agricultural products. Product differentiation is the key to the success of trade within SSA. The main challenge is therefore industrialization and manufacturing product in different varieties.

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Appendix

Table 2: Average Trade relations, GDP per Capita and Capital to Labor ratio of SSA Countries from 1997 to 2007

Country Name	Average # of Trade Relations	Average GDP per Capita	Average Capital to Labor Ratio
Angola	27	1218	384
Benin	35	452	209
Burkina Faso	31	299	124
Burundi	24	113	20
Cameroon	35	786	357
Cape Verde	32	1668	1309
[1]CAF	30	302	62
Chad	26	337	216
Comoros	21	515	126
[2]DRC	32	115	29
Congo, Republic	35	1265	739
Côte d'Ivoire	31	763	215
Equatorial Guinea	20	7433	8337
Ethiopia	27	148	73
Gabon	32	5084	2928
Gambia	32	318	153
Ghana	32	481	251
Guinea	34	388	152
Guinea-Bissau	13	173	63
Kenya	36	483	179
Madagascar	35	284	118
Malawi	31	204	84
Mali	31	319	278
Mauritius	35	4430	2486
Mozambique	31	266	113
Niger	29	202	87
Rwanda	32	266	93
Senegal	35	631	339
Sierra Leone	29	212	57
South Africa	36	3904	1938
Tanzania	36	318	133
Togo	30	305	127
Uganda	35	282	132
Zambia	36	503	276
Zimbabwe	31	509	126
Liberia	22	168	53

[1]Central African Republic

[2]Democratic Republic of Congo

Source: Author's calculation using WDI and DOT database.

Table 3: Regional Difference in Factor Endowment Ratio and Average capital per Worker [1970-2007]

Region Name	[1]DKLR			[2]AV. VKL
	Mean	Minimum	Maximum	
Europe and North America	6349	0.03	32939	10,043
East and South Asia	5231	0.41	20287	3,746
Middle East and North Africa	3627	2.18	15070	3,234
Latin America and Caribbean	2074	0.56	15133	2,219
Sub-Saharan Africa	845	0.03	18182	546

[1]Difference in Capital to Labor Ratio; [2]Average Value of Capital per Worker ($U.S)

Source: Author's calculation using WDI data.

Table 4: Regional Grubel Llyod Index, Homogeneous and Differentiated Goods [1997-2007]

Region Name	Grubel Llyod Index			[1]DG(%)	[2]HG(%)
	Mean	Minimum	Maximum		
East and South Asia	0.12	0.00	0.28	70	30
Europe and North America	0.24	0.00	0.43	72	28
Latin America and Caribbean	0.05	0.00	0.16	34	66
Middle East and North Africa	0.05	0.00	0.17	34	66
Sub-Saharan Africa	0.03	0.00	0.11	40	60

[1]Share of differentiated goods in total imports, [2]Share of homogeneous goods in total imports.

Source: Author's calculation using UNCOMTRADE data.

Table 5: Statistics on SSA Countries' Trade in Differentiated Goods from 1997-2007

Reporter Name	Import Value (Million $U.S.)	Export Value (Million $U.S.)	Regional Share (percentage)	[2]Gli
South Africa	42781.6	6502.3	47.16	0.027
Kenya	3107.8	1650.9	4.55	0.023
Zimbabwe	1153.0	3556.7	4.51	0.031
Mozambique	246.0	4112.8	4.17	0.027
Nigeria	644.9	3177.5	3.66	0.029
Côte d'Ivoire	3090.1	679.0	3.61	0.027
Ghana	609.0	3034.7	3.49	0.027
Tanzania	475.8	2448.3	2.80	0.025
Burkina Faso	309.8	2347.3	2.54	0.026
Mali	73.7	2440.0	2.41	0.026
Malawi	366.4	2073.4	2.33	0.027
Mauritius	906.0	1263.2	2.08	0.023
Senegal	1394.0	756.2	2.06	0.023
Togo	1024.2	1103.5	2.04	0.029
Uganda	137.8	1584.3	1.65	0.021
Botswana	993.6	620.8	1.54	0.033
Benin	652.1	911.7	1.50	0.027
Madagascar	129.3	1249.1	1.32	0.021
Cameroon	447.1	819.2	1.21	0.025
Guinea	38.9	745.3	0.75	0.022
Gabon	126.5	640.5	0.73	0.022
Niger	92.2	504.1	0.57	0.024
Namibia	457.8	58.6	0.49	0.031
Rwanda	20.9	470.7	0.47	0.025
Ethiopia	28.2	416.8	0.43	0.024
Seychelles	37.1	380.4	0.40	0.022
Gambia	32.5	383.3	0.40	0.022
Burundi	16.2	306.1	0.31	0.023
Sierra Leone	21.7	239.0	0.25	0.024
Guinea-Bissau	28.8	173.2	0.19	0.022
[1]CAF	4.5	145.3	0.14	0.020
Comoros	3.5	119.8	0.12	0.021
Eritrea	18.2	41.1	0.06	0.024
Cape Verde	14.3	38.3	0.05	0.022
São Tomé and Príncipe	7.6	10.3	0.02	0.026

[1]Central African Republic

[2]The Grubel Llyod index (Gli) takes the maximum value of 1 for intensive intra industrial trade (importvalue = expport value), the minimum value of the Gli is 0 (in case of only import or export). Lower Gli means less intra industrial trade flows.

Source: Author's calculation using UNCOMTRADE data.

Table 6: Estimation of Equation (4) Using Pooled Panel OLS

VARIABLES	(Asia) M^{ijt}	(EU_NAM) M^{ijt}	(LAC) M^{ijt}	(MENA) M^{ijt}	(SSA) M^{ijt}
$Y^{it}Y^{jt}/Y^{rt}$	0.15***	0.08***	0.04***	0.03***	0.04***
	(0.00162)	(0.00168)	(0.00176)	(0.00188)	(0.000793)
LL^{i}	0.319	-2.807***	-0.0573		0.00789***
	(0.628)	(0.938)	(0.0542)		(0.00284)
CL^{ij}	2.332***	10.78***	-0.0188	0.0955***	0.00391
	(0.547)	(1.386)	(0.0290)	(0.0299)	(0.00270)
col^{i}	-8.999***	11.03***	-0.511**		-0.116**
	(2.658)	(1.463)	(0.256)		(0.0462)
D^{ij}	-0.671**	-12.35***	-0.0288	-0.0158	-0.00285
	(0.317)	(1.617)	(0.0198)	(0.0164)	(0.00206)
$contig^{ij}$	2.381**	-2.857***	0.438***	0.0963**	0.0308***
	(0.927)	(0.447)	(0.0520)	(0.0458)	(0.00530)
Constant	5.063*	22.28***	0.255	0.0288	0.0151
	(2.672)	(3.365)	(0.160)	(0.133)	(0.0167)
Observations	6,170	9,900	6,339	2,907	12,135
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Goups	606	900	631	273	1,190

Note: ***, **, and * represent respectively 99, 95, and 90 percent significance.

The heteroscedasticity- consistent standard errors are in parentheses.

Table 7: Benchmark Case: Estimating Equation (4) for Different Classes of GL and DFER[1]

	Heckscher-Ohlin Model: Low Grubel Lloyd Sample: GL<0.05		IRS/ Heckscher-Ohlin Model: High- Grubel-Lloyd Sample: GL>0.05			
	V_i Ranked by increasing DFER Order		V_i Ranked by Increasing GL Order		V_i Ranked by Increasing DFER Order	
	α_{ϑ}^{it}	*standard error*	α_{ϑ}^{it}	*standard error*	α_{ϑ}^{it}	*standard error*
ϑ= 1	0.002**	(0.000825)	0.013***	(0.000432)	0.088***	(0.00220)
ϑ= 2	0.003**	(0.00119)	0.032***	(0.000594)	0.060***	(0.00204)
ϑ= 3	0.011***	(0.000542)	0.153***	(0.00205)	0.059***	(0.00196)
ϑ= 4	0.012***	(0.000699)	0.265***	(0.00413)	0.136***	(0.00397)
ϑ= 5	0.005***	(0.000731)	0.070***	(0.00230)	0.123***	(0.00160)
All Observations	0.010***	(0.000334)	0.088***	(0.00111)	0.088***	(0.00111)

[1]Difference in Factor Endowment Ratio.

Table 8: Correlation Matrix

	M^{ijt}	$(y^i y^j / y^r)$	LL	CL	Col	Contig	distance
M^{ijt}	1						
$(y^i y^j / y^r)$	0.49	1					
LL	-0.051	-0.0604	1				
CL	-0.0201	-0.053	0.0352	1			
Col	0.0914	0.218	-0.0153	0.0106	1		
Contig	0.1638	0.0134	0.0651	0.1205	0.1093	1	
distance	-0.1378	0.0459	-0.0403	0.0058	-0.1105	-0.4479	1